Nora Loose

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Research Interests

Physical & computational oceanography, Ocean mesoscale eddy parameterizations, North Atlantic-Arctic connectivity, Ocean observing system design, Adjoint modeling, Data assimilation, Uncertainty quantification, Scientific software development

Education

01/2015 - 08/2019 **University of Bergen**, Bergen, Norway.
Ph.D. in **Physical Oceanography**
- Thesis: *Adjoint Modeling and Observing System Design in the Subpolar North Atlantic*
- Advisors: Kerim H. Nisancioglu (University of Bergen), Patrick Heimbach (UT Austin)
- Funded by European Research Council project ice2ice

04/2007 - 02/2013 **University of Bonn**, Bonn, Germany.
Diploma (equiv. M.Sc. degree) in **Mathematics**, **with Honors**
- Specialization: Stochastic Analysis; Minor: Physics
- Grade Point Average: 1.0, on a scale from 1.0 (excellent) to 4.0 (pass)

Research Experience

10/2020 - present **Postdoctoral Associate**, *Department of Applied Mathematics*, University of Colorado, Boulder.
- Member of the Ocean Transport and Eddy Energy Climate Process Team
- Improve ocean mesoscale eddy parameterizations via an energetically-consistent framework
- Develop open source software for spatial filtering of gridded geophysical data
- Mentor: Ian Grooms

09/2019 - 09/2020 **Postdoctoral Fellow**, *Oden Institute for Computational Engineering and Sciences*, University of Texas at Austin.
- Leveraged uncertainty quantification & data assimilation for ocean observing system design
- Mentor: Patrick Heimbach

1/2015 - 06/2018 **Graduate Researcher**, *Department of Earth Science*, University of Bergen, Norway.
- Investigated oceanic teleconnections in the North Atlantic, Nordic Seas, and Arctic Ocean
- Quantified uncertainties in ocean state estimates for present-day and paleoclimates

03/2013 - 08/2014 **Doctoral Research Fellow**, *Department of Mathematics*, ETH Zurich, Switzerland.
- Conducted research in the fields of Geometric Analysis and Partial Differential Equations
- Assisted in teaching undergraduate and graduate level courses

Teaching and Outreach

08/2020 **Science Communication**.
- Worked with Science Educator Annette deCharon to develop a ArcGis Story Map that explains adjoint modeling and a recent research article to a broader audience

02/2020 **Volunteer**, *Girl Day STEM Festival*, UT Austin.
- Hands-on science activities and demonstrations for elementary and middle school students

03/2013 - 08/2014 **Teaching Assistant**, *Department of Mathematics*, ETH Zurich, Switzerland.
- Taught 3 graduate level math courses (*Measure Theory & Integrals, Differential Geometry I, II*)
- *Teaching evaluations*: 4.8 (2013), 4.9 (2014) on a scale from 1 (very bad) to 5 (excellent)

07/2013 **Teaching Assistant**, *PCMI Graduate Summer School*, Park City, UT.
- Taught advanced math course (*Weak immersions of surfaces with L^2-bounded second fundamental form*, lecture notes) for Ph.D. students and postdocs

10/2008 - 02/2013 **Teaching Assistant**, *Department of Mathematics*, University of Bonn, Germany.
- Taught 3 undergraduate level math courses (*Mathematics for Physicists I, Analysis II, III*)

01/2010 - 04/2010 **Teaching Assistant**, *Department of Mathematics*, University of Toronto, Canada.
- Taught undergraduate level math course (*Linear Algebra*)

2009 - 2011 **Student Assistant**, *Hausdorff Center for Mathematics*, University of Bonn, Germany.
- Organized and led math outreach events for students from elementary and secondary school

Grants, Awards and Scholarships

Grants

08/2021- 07/2025 **NSF CSSI Grant**, *National Science Foundation*, $166,590.
- Project: Collaborative Research: Frameworks: Convergence of Bayesian inverse methods and scientific machine learning in Earth system models through universal differentiable programming
- Role: Principal Investigator

02/2016 **Research Grant**, *Norwegian Research School in Climate Dynamics*, NOK 20,000.
- for research stay at MIT

Awards

04/2019 **Rising Stars in Computational & Data Sciences**, *Oden Institute for Computational Engineering and Sciences*, University of Texas at Austin.
- Selected for competitive, international career event for women in Computational & Data Sciences

03/2018 **Best Presentation Award**, *Research School on Changing Climates in the Coupled Earth System*, Sommarøy, Norway.

02/2013 **Award "Diploma with Honors"**, *Department of Mathematics, University of Bonn, Germany*, for graduating with highest possible grade point average.

2008 - 2012 **German Academic Scholarship Foundation Award**, *Studienstiftung des deutschen Volkes*, for outstanding academic achievements (given to 0.5% of students in Germany).

2006 **3 Awards**, *for exceptional results in high-school final exams on state-wide basis*.
- *Porsche AG*: for excellent performance in mathematics and physics
- *German Physical Society*: for excellent performance in physics
- *Reinhold Beitlich Foundation*: for exceptional overall performance

Professional Service

Peer review service

Geophysical Research Letters, Journal of Advances in Modeling Earth Systems, Journal of Climate, Journal of Physical Oceanography

Review of proposals

Panelist for reviewing NASA ROSES proposals

Organization of Conferences

02/2022 Co-Convener for the session "Mesoscale Eddy Energy and Ocean Transport", Ocean Sciences Meeting 2022.

04/2017 Co-Convener for the session "Quaternary climate archives and proxy uncertainty", EGU General Assembly 2017.

09/2015 Co-Organizer of PhD conference "Connecting the ocean, atmosphere and ice sheets", 20 participants, Denmark.

Publications

Journal Arcticles

J1 Y. Fujii, E. Rémy, H. Zuo, P. Oke, G. Halliwell, F. Gasparin, M. Benkiran, **N. Loose**, J. Cummings, J. Xie, Y. Xue, S. Masuda, G.C. Smith, M. Balmaseda, C. Germineaud, D.J. Lea, G. Larnicol, L. Bertino, A. Bonaduce, P. Brasseur, C. Donlon, P. Heimbach, Y. Kim, V. Kourafalou, P-Y. Le Traon, M. Martin, S. Paturi, B. Tranchant and N. Usui. Observing System Evaluation Based on Ocean Data Assimilation and Prediction Systems: On-Going Challenges and a Future Vision for Designing and Supporting Ocean Observational Networks, *Front. Mar. Sci. 6:417*, 2019. doi: 10.3389/fmars.2019.00417.

J2 **N. Loose**, P. Heimbach, H. Pillar and K.H. Nisancioglu. Quantifying Dynamical Proxy Potential through Shared Adjustment Physics in the North Atlantic. *Journal of Geophysical Research: Oceans 125, no. 9*, 2020. doi: 10.1029/2020JC016112. Selected as Eos Research Spotlight.

J3 **N. Loose** and P. Heimbach. Leveraging Uncertainty Quantification to Design Ocean Climate Observing Systems, *Journal of Advances in Modeling Earth Systems*, 13, e2020MS002386, 2021. doi: 10.1029/2020MS002386.

J4 I. Grooms, **N. Loose**, R. Abernathey, J.M. Steinberg, S.D. Bachman, G. Marques, A.P. Guillaumin, E. Yankovsky. Diffusion-Based Smoothers for Spatial Filtering of Gridded Geophysical Data, *Journal of Advances in Modeling Earth Systems*, 13, e2021MS002552, 2021. doi: 10.1029/2021MS002552.

Thesis

T1 **N. Loose**. Adjoint Modeling and Observing System Design in the Subpolar North Atlantic, *Ph.D. Dissertation*, University of Bergen, 2019. http://bora.uib.no/handle/1956/24456.

Presentations

Invited Talks

06/2020 **IARPC Joint Modeling-Arctic Observing Systems Sub-Team Meeting**, *Online*.
Looking at observing systems through the lens of models: Targeted Observations

04/2018 **EGU General Assembly 2018 (solicited)**, *Vienna, Austria*.
How informative are SST proxy data in paleoceanographic inverse modeling?

03/2018 **Northumbria University**, *Newcastle, UK*.
Uncertainty Quantification and Constraints on Subsurface Heat Content at Greenland's Margins

Selected Conference Presentations

02/2021 **2021 CESM Ocean Model Working Group Meeting**, *Online*.
Diagnosing and parameterizing the energy budget of ocean mesoscale eddies in an idealized model

02/2020 **Ocean Sciences Meeting 2020**, *San Diego, CA*.
The Dynamical Proxy Potential of the OSNAP Array

10/2018 **ECCO Meeting**, *Austin, TX*.
Comprehensive Observing System Design within the ECCO Framework

07/2018 **Workshop on Sensitivity Analysis and Data Assimilation in Meteorology and Oceanography**, *Aveiro, Portugal*.
Uncertainty Quantification as a Tool for Observing System Design - An Oceanographic Perspective

06/2018 **Adjoint (TACOMA) Workshop**, *Oxford, UK*.
Adjoints as a Tool for Observing System Design

Selected Poster Presentations

06/2017 **Data Assimilation Workshop**, *Bergen, Norway*.
How Informative are Paleoceanographic Observations for an Inverse Problem?

05/2017 **Past Global Changes (PAGES) Workshop**, *Louvain-la-Neuve, Belgium*.
How Informative are Paleoceanographic Observations for an Inverse Problem?

03/2017 **Workshop on Emerging Applications of Data Assimilation in the Geosciences**, *Leiden, Netherlands*.
Uncertainty Quantification for Adjoint-Based Data Assimilation with Sparse Data

Field Work

07/2017 - 08/2017 **East Greenland Ice-Core Project (EastGRIP)**, *Greenland*.
- Drilled shallow ice cores, conducted surface measurements and lab work in the science trench

08/2016 - 09/2016 **G.O. Sars**, *Irminger Sea*.
- Collected physical oceanographic data and marine sediment cores for the ice2ice project (ERC)

Skills

Programming

- Python, MATLAB, Fortran, Unix/Linux, Git, LaTeX.

Languages

- *Fluent in:* German, English, Norwegian; *Basic knowledge in:* Spanish, Italian.